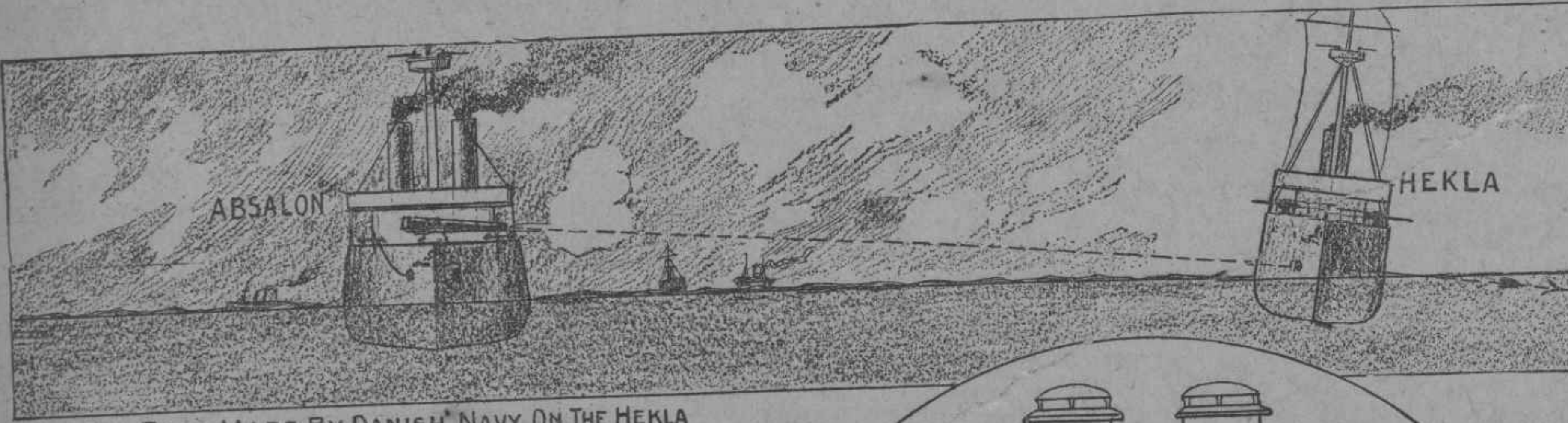
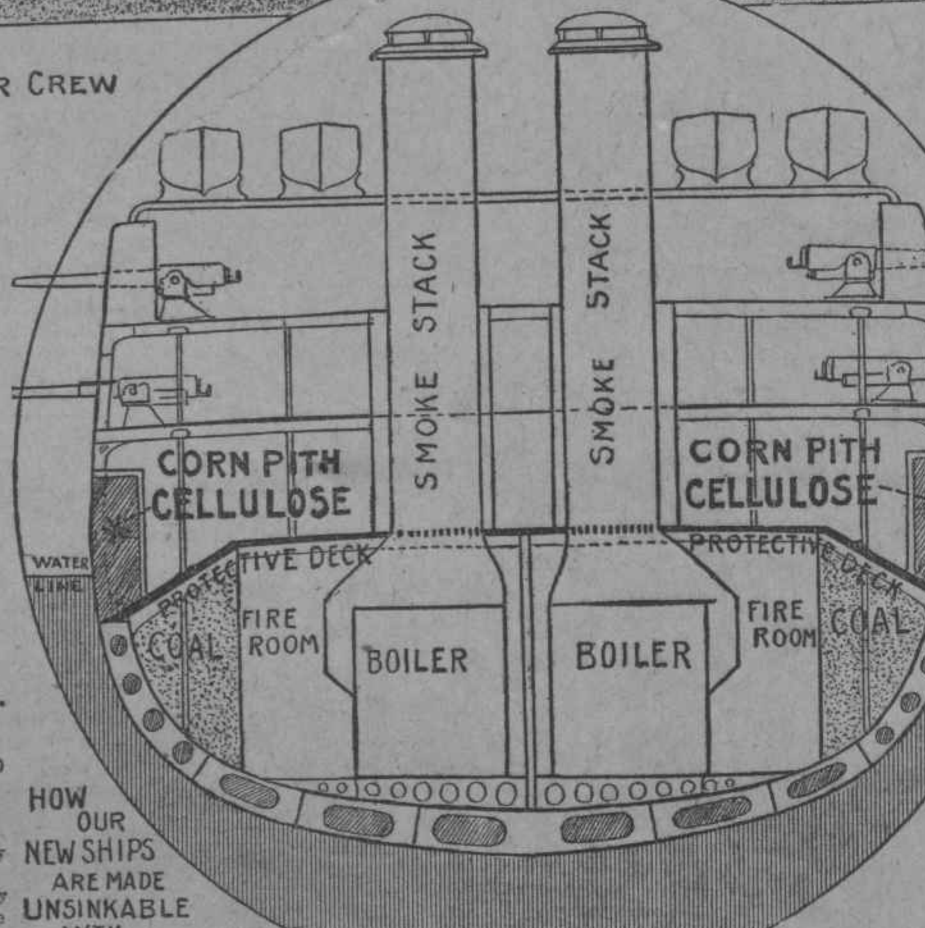
HOW ALL OUR NEW WAR SHIPS WILL BE MADE UNSINKABLE.

OUR NEW BATTLE SHIPS ARE BEING LINED WITH A SEVEN-FOOT BELT OF CORNPITH ALONG THE WATER LINE, WHICH WILL KEEP THEM AFLOAT EVEN IF RIDDLED BY SHELLS.



ACTUAL TEST MADE BY DANISH NAVY ON THE HEKLA WITH A VOLUNTEER CREW



HOW OUR NEW SHIPS ARE MADE UNSINKABLE WITH CORN PITH

THE Navy Department has discovered a way of making war ships practically unsinkable. It is by placing around them on the inside of the steel hulls a belt of corn pith packing three feet in thickness along the water line. The new battle ships Illinois, Kearsarge, Alabama and Kentucky, which have been launched this year, have this protection, and it is being put on the other battle ships now building. A test on the Danish cruiser Hekla, with an inferior kind of packing, showed that by this means a war ship may be hit at the water line, the projectile going clear through the ship, and the holes will close automatically, preventing the water from pouring in and sinking it. In this way it is thought that modern steel ships can be made as buoyant and hard to sink as the old wooden ships. The way in which common corn pith's usefulness was discovered as armor for war ships, the method by which it is prepared and how it is being adopted all over the world for naval purposes, is exceedingly interesting. This also adds a new and incalculable source of wealth to corn growing districts of this country.

HOW TO INCREASE EFFICIENCY OF AMERICAN WAR SHIPS.

By Henry W. Cramp, of the Famous Firm of War Ship Builders.

THE discovery and application of corn pith is of as vital importance to our navy as the development of Kruppized armor and smokeless powder.

This product of American farms affords a cheap and ready means of vastly increased efficiency for our cruisers and the unarmored sides of all our vessels we have these belts without delay. Without adding much to the cost of our vessels we can greatly increase the efficiency of them all by making their sides automatically resist the inflow of water.

As our cruisers carry heavier batteries than similar vessels of other nations they would, when so protected, be able to give battle to ships far heavier than themselves.

A cellulose belt of three feet in thickness may be said to be as efficient as a six-inch belt of steel. By this means 100 tons of cellulose becomes equivalent to 1,000 tons of armor.

AFTER a series of experiments extending over three years the United States Government has found a method of making our war ships practically unsinkable.

It is by placing over the inside of the hull a packing of corn pith along the water line. This simple device is more than a match for the most powerful shell from an enemy's gun. It does not stop the projectile, it simply allows it to go clear through both sides of the ship if it can, while the holes made in the ship's side close up as if the shell had gone through a sponge.

Strange as this may seem, it is accounted for by the fact that this corn pith lining swells up as soon as the water enters the hole made by the projectile. Before the inrush of water has penetrated half way through this three-foot belt the corn pith has swelled and completely closed the hole, so that not a drop of water enters the ship.

This removes one of the most dangerous features of steel war ships—that is, their tendency to sink almost instantly on being pierced by a projectile below the water line. The old wooden war vessels in previous times could be fairly riddled with holes and yet keep afloat. The swelling of the wood and the ease with which they could be plugged made it hard to sink them.

The great horror of recent naval wars with modern steel vessels has been the fearful quickness with which war ships were sent to the bottom. Dewey illustrated this on the Spanish ships at Manila.

In the battle of the Yalu in the war between Japan and China, the Chinese armored cruisers Tschi-Yuen and King-Yuen were sunk by being pierced at the water line.

The new battle ships which have been launched this year, the Illinois, the Kentucky, the Alabama and the Kearsarge, have all been provided with this lining of corn pith. The Wisconsin, soon to be launched, will have the same equipment.

On these big battle ships, designed to be the finest ships of their class in the world, the corn pith is packed in coffer-dams three feet thick. They are not placed behind the heavy armor, but extend from the ends of the armor, which protects the middle portions, or vitals of the ship, clear around the bow and stern. This thick lining is four feet above and three feet below the water line. The corn pith is packed to a density of six pounds to the square foot.

Mr. Henry W. Cramp, the great war ship builder, has calculated that this corn pith lining is equal to a six-inch belt of steel armor in defensive value, and a single hundred tons of it equals a thousands tons of steel armor.

The idea of protecting war ships by a lining of this sort is not altogether new. Abroad several countries have tried various kinds of cellulose for this purpose. Italy, France, Germany, Russia, Austria, Denmark, and the Netherlands have experimented, but in none of those countries has pith lining of any kind been permanently adopted. Yet some of their tests have been highly successful.

The most interesting experiment of this kind that had all the dramatic features of an incident of real warfare occurred in Denmark some time ago. The cruiser Hekla was selected as the vessel to be experimented on by having a shell fired clear through her near the water line. The war ship Absalon, also of the Danish navy, was to play the part of the enemy and to fire the shell through the Hekla.

It took a plucky crew to man the Hekla for a test like this, but volunteers came forward. Going upon the Hekla they took up their various stations on the vessel, except on the bow, where the shot was to be aimed at.

It was a hair-raising moment while those officers and men stood at their posts, as if in actual battle, the captain upon the bridge, the engineer at his station ready to throw the levers if the ship was not shattered at the shot.

The Absalon had drawn up at a distance of a hundred feet, near enough to send a shot clean through her sister ship. Then from her five-inch gun rose a roar and a puff of smoke.

The Hekla shivered like a living thing as the projectile ploughed through her bow, true to the gunner's aim. A clean five-inch hole had been cut through the steel frame from the starboard to the port side six inches above the water line. But inside the bow had been packed with cocoa fibre, or cellulose. The question was whether this cellulose could stop the flow of water quickly enough to prevent the vessel from sinking when her bow was submerged.

The Hekla was started forward at full speed, at sixteen knots, raising a bow wave four feet high. This was a tremendous pressure of water to put on the part of the ship that had been pierced by a five-inch shell. But, strangely enough, no water came through for fifty-five minutes. The cocoa fibe had instantly expanded and filled the hole made by the passage of the shell. As soon as the water came in contact with the cellulose it was absorbed as by a sponge.

At the end of fifty-five minutes several drops of water appeared on the inside of the starboard bow, and in sixty-five minutes a few drops showed on the port side. In an hour and a quarter water appeared in the drain pipes of the port cells, and in two hours in those of the starboard cells. The flow continued to increase for two and a half hours, when it gradually diminished during the last half hour.

During the three hours in which the holes were completely submerged by the bow wave only 7 1-3 cubic feet of water entered the vessel. The test was a decided success.

One would have thought that after such an object lesson that foreign nations would have immediately adopted this kind of protection for their war ships. But various troubles arose. It was found that cellulose became putrid in time, lost its absorptive qualities and made such a stench that it had to be removed. It also happened that it would catch fire.

But all the while these difficulties were perplexing foreign powers American genius was at work. By a certain chemical treatment it was found that this light fibrous substance, made either from cocoanuts or wood, could be prevented from decaying. Then came the discovery that it could be made non-combustible.

But the greatest discovery was yet to come, and that was instead of cocoanuts, wood fibre or any of the other substances that had hitherto been used for this purpose, the ideal cellulose could be made of corn pith, that light, fluffy stuff inside of cornstalks.

Here in this great corn-growing country was an absolutely inexhaustible supply of the cheapest material imaginable. At first the idea that the waste substance of the cornfields would make the best kind of armor for war ships seemed the height of absurdity. That was about three years ago. Government experts took hold of the problem, however, in an unbiased way, and proceeded to make tests.

Cocoanut fibre had previously been considered the best cellulose substance known. For that reason it had been used on the crack cruisers New York, Columbia and Olympia. A set of trials was arranged between cocoa fibre and its new rival, corn pith.

In order to make a comparative test of this new cellulose, the Navy Department made two coffer-dams of steel plates, stiffened by angles, 6 feet high, 6 feet wide and 3 feet thick. In one was placed 832½ pounds of cocoa cellulose and fibre mixed to the usual proportions, corresponding to a density of 7.7 pounds to the cubic foot. The other coffer-dam was packed with corn pith containing [illegible] pounds, corresponding to a density of 6.5 pounds per cubic foot. These coffer-dams were sent to the Indian Head proving ground, and were fired at.

The first shot was fired at the cocoa coffer-dam. A 6-inch shot having a velocity of 1,000 feet per second, was fired into the cocoa cellulose with the gun at a distance of 314 feet. The hole made at the point of entry was the diameter of the shot, and that at the point of exit at the rear of the coffer-dam was an irregular jagged hole 7½x8½ inches. The centre of the hole was five feet below the top of the coffer-dam.

The passage of the shot caused a quantity of cellulose to be projected to the front through the hole made, and about a quart thrown out to the rear. Water was now applied to the front of the coffee-dam, the level being five feet above the hole. In ten minutes the first drop of water appeared through the hole. The flow increased gradually, and in a few minutes had become comparatively steady, running about 12 gallons in one-half hour. The flow of one-half gallon a minute then became approximately constant.

In the meantime the cofferdam containing the corn pith was fired at under similar conditions. Water was turned on as before and left for one and a half hours, during which time no water whatever appeared at the hole in the rear of the coffer-dam, nor at the end of the time had the corn cellulose at the mouth of the hole in the rear become damp. The coffer-dam containing cocoa cellulose was now fired at with a 250-pound eight-inch shell, at the same distance, and with the same velocity as that of the six-inch shell.

The hole in the front was the size of the shell. In the rear a rough hole was made about 12x9 inches. About a pint of cellulose was thrown out from the front hole, and about one-half gallon from the hole in the rear. The water was then turned on with a head of about five feet as before. In twenty-five seconds a few drops appeared at the hole in the rear, and about twelve gallons had passed through in thirty minutes. In about half an hour the flow had settled down to a practical steady rate, or about one-half gallon a minute. Under similar conditions an eight-inch projectile was now fired at the corn cofferdam, the conditions of firing being the same in both cases.

The water was turned on, and after waiting forty-five minutes no water appeared at the hole in the rear of the coffer-dam nor was the corn at the rear damp. No water had appeared at the eight-inch hole which had previously been made, nor was it damp at the completion of the experiment.

It was found that the cocoa fibre had become damp all along the path of the shell and extending several inches below and above it. But the corn pith was damp only through twenty-four inches of the path of the six-inch shell and to a distance of twenty-six inches in the case of the eight-inch shell.

Tests were also made to show the relative non combustibility of the materials. A portion of the material was placed loose in an iron envelope and a 3 pound shell containing one-tenth of a pound of powder was exploded in its midst. A 1-pound bag of powder was exploded in a similar manner, in which case the cocoa cellulose ignited; the corn pith did not, but was greatly charred. Cocoa and corn cellulose were then packed separately in bags of a cubic foot capacity, and two gallons of fresh water were poured into each box. The boxes were then placed in the basement of the Navy Department, and examined from time to time.

About a month later, it was found that the cocoa cellulose, which had been in contact with the iron, had turned black, and that the iron showed corrosion, except where painted, and there the paint had softened, due to the action of the cellulose. The corn pith showed that the painted portions were intact, and the paint was much more firm, and that in contact with the iron was only slightly black in some parts and the iron very slightly corroded; hardly more would it have been the case had it simply been in contact with the moisture, showing that the corn had practically no effect.

After these exhaustive tests, which showed in a striking manner the superiority of the corn pith cellulose, the Navy Department's specifications for the battleships Kentucky and Kearsarge and Nos. 7, 8 and 9 contain a clause requiring the coffer-dams of these battleships to be packed with this substance.

Not only does the American cellulose show much greater absorptive and stopping powers than the cocoa cellulose, but it does not require to be packed to the same density in order to accomplish the same results.

The cocoa fibre is packed to 7½ pounds to the cubic foot, and the corn pith to 6 pounds. It is $100 per ton cheaper than the cocoa fibre. With the corn piths lesser density makes it cost but little more than half as much. After this successful test in the United States other countries were eager to experiment with our corn pitch. On the 18th of last January a severe trial was made of it at Portsmouth, England, on board H. M. S. Nettle. The results were as satisfactory as those made in this country. Two months ago the Russian Admiralty made a test of this same kind of cellulose at their naval proving grounds at Poligon, near St. Petersburg.

The material was supplied by a Philadelphia company, and the coffer-dam was packed under the supervision of American experts.

The experiment conclusively demonstrated that a ship provided with a coffer-dam packed as was the one used in the experiment could be perforated 5 feet below the water line without the least danger of the entrance of water.

The corn-pith cellulose was discovered by Mr. M. W. Marsden, who brought it to the notice of the Navy Department.

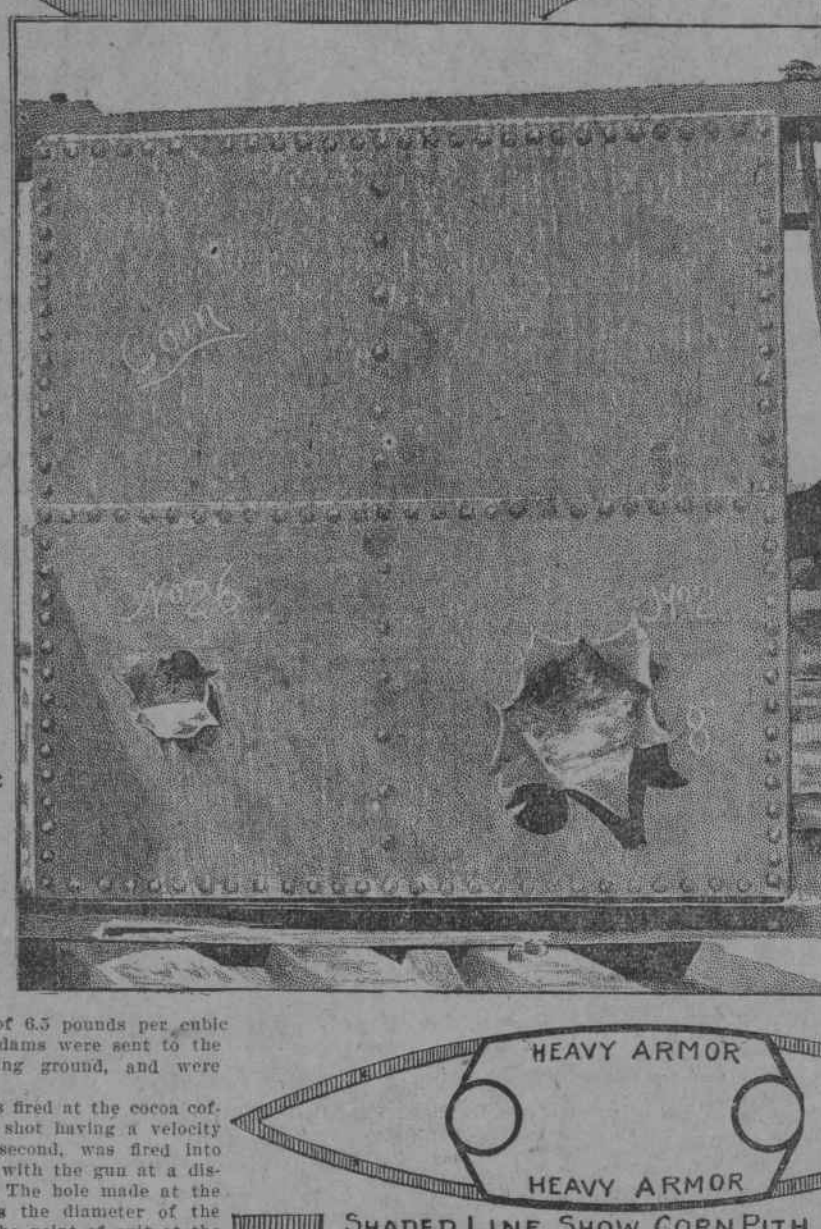
Early in 1896 a plant for the manufacture of the corn-pith cellulose was erected at Owensboro, in the corn belt of Kentucky, the machinery being specially adapted by Mr. Marsden.

The process of manufacture is of considerable interest. The large, untrimmed cornstalks, after being thoroughly dried, are fed into a cutting machine, and there cut into pieces of about an inch in length, after which they fall into the receiver of a pneumatic conveyor, which consists of a system of galvanized piping of the size of ordinary stove piping, through which a strong current of air is forced by centrifugal fans.

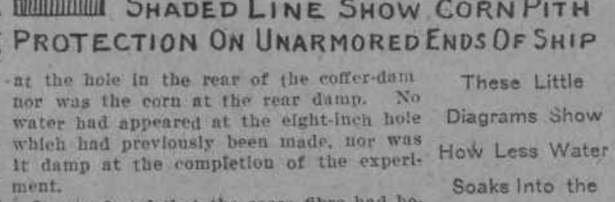
The air blast in the pneumatic conveyor separates the leaves and lighter parts and blows them up through one branch pipe to one loft, while the heavier pieces of stalks pass through another pipe to a second loft and are blown through a grating to remove any remaining leaves. The cut stalks are then fed into another branch of the conveyor and are carried to a large hopper, whence they pass into an attrition mill, which cracks the shell and releases the pith and its fibre.

This whole disintegrated mass then passes into a large rectangular box with conical ends at top and bottom, into which ends lead pipes of another pneumatic conveyor. This box is called the cyclone, the strong currents of air within being so directed as to blow the pith and its fibre upward, and the pieces of the shell of the stalk downward, where the latter are ground and reground with the leaves as feed for cattle.

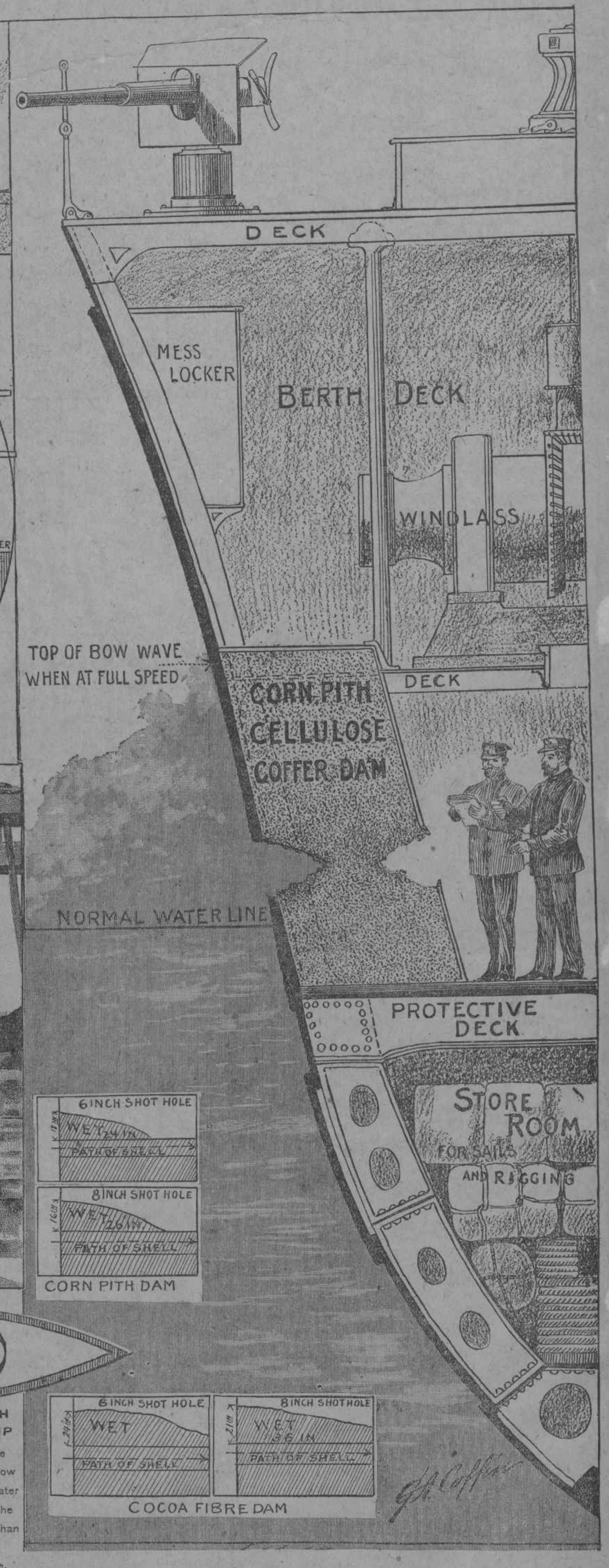
The pith and fibre, blown upward, pass into a double concentric cylindrical screen which, revolving slowly in an air-tight compartment, sifts out all the dust. Then there remains only the coarse cellulose and its fibre, and the fine cellulose, which is like flour, and these are again separated by air blast and fall in different compartments. The coarse cellulose and fibre is now ready for chemical treatment, to render it fire proof, after which it ready for the press.



Tests Made by Firing Six and Eight Inch Projectiles Into Coffer-dams Packed with Corn Pith Show That the Corn Pith Swells Up and Keeps the Water Out.



SHADED LINE SHOW CORN PITH PROTECTION ON UNARMORED ENDS OF SHIP



These Little Diagrams Show How Less Water Soaks Into the Corn Pith Than Into the Cocoa Fibre.

How the Hekla's bow was pierced by a shell and the water prevented from flowing in by the swelling of the cellulose, which completely closed the hole.